REMARKS

This amendment is submitted in response to the Final Office Action dated October 29, 2002. A Request for Continued Examination is filed herewith. A petition for a three month extension of time is enclosed herewith to bring the date of response to January 29, 2003. Claims 14, 19 and 49 are amended to more clearly point out and distinctively claim the invention. For example in claim 14, the term "desirable" has been deleted, a value for aonset has been added, and the claim is restructured such that the criteria for the propellant is placed at the end of the claim. Claim 19 is amended to recite a specific propellant comprised of a mixture of one or more paraffin waxes and carbon black in a certain concentration range. Claims 15 to 18 and 21 are cancelled.

35 U.S.C. 112 Rejections

The Examiner rejects claims 14-19, 21 and 49 under 35 U.S.C. 112, second paragraph as being indefinite. Applicant respectfully traverses this rejection and submits that the amended claims are definite.

Applicant has deleted the term "desirable" and has provided a range of values for a_{onset}. As discussed in the specification at page 22, the range of values recited for a_{onset} set forth the requisite degree to promote entrainment of propellant droplets into the gas stream. Moreover, claim 49 recites a propellant having a liquid layer with specific viscosity and surface tension values. Claim 19 recites a specific propellant composition. Applicant respectfully submits that the amended claims clearly set forth the metes and bounds of the invention.

The Examiner rejects claims 14-19, 21 and 49 under 35 U.S.C. 112, first paragraph as containing subject matter not enabled. Applicant respectfully traverse this rejection and submits that the claims are enabled by the specification.

The Examiner recites *PPG Industries*, and the *In re Wands* factors. The dominant Wands factors may be summarized as follows:

1. the quantity of experimentation necessary;
2. the amount of direction or guidance presented in the application;
3. the presence or absence of working examples of the invention in the application;
4. the nature of the invention;
5. the state of the prior art;
6. the relative skill of those in the are;
7. the predictability or unpredictability in the art; and
8. the breadth of the claimed invention.

Regarding quantity, guidance and working examples, the specification clearly sets forth guidelines and provides specific examples for determining the value of a_{onset} as recited in Claim 14. Regarding the equation for a_{onset}, the relationship was not known in the field, but has been discovered and developed by the inventors. This development and the applicability of the relationship is described in the application, specifically at pages 31 to 36 of the application. For example, the last sentence on page 31 states "....the method of selecting a high regression rate fuel is provided in stepwise fashion as follows." There follows on pages 32 and 33 the stepwise procedure. Specific examples are shown on pages 34 and 35 for a paraffin wax with a melting point of 66.6 °C. Values of B are taught on page 33, and finally in Table 2 values of a_{onset} are shown for six other compounds. Table 2 includes all of the physical data needed to calculate a_{onset} using the values of B as suggested in the application. Contrary to the Examiner's assertion, Applicant submits that this is detailed guidance, clearly delineated in stepwise fashion.

Additionally, the entrainment onset parameter a_{onset} is clearly described for example at pages 21 to 24, and the values where entrainment will occur are shown on page 22. Applicant respectfully submits that those of ordinary skill in the art can calculate the entrainment onset parameter for materials of interest given the teaching of the present invention. Once that parameter is known, it is then compared with the values given in equation 18, page 22, to predict whether entrainment is likely to occur. At page 22, specific ranges of values of a_{onset} are provided showing where the best results are expected. Pages 32 to 36 give specific examples.

Applicant submits that one of ordinary skill in the art can calculate a_{onset} and determine whether a candidate fuel is likely to satisfy a value of a_{onset} equal to or less than 0.9 and thus entrain according to the method of the present invention and recited in Claim 14.

The nature of the invention is rocket science, and those skilled in this field are well educated and accustom to experimentation. The fact that experimentation may be complex does not necessarily make it undue particularly if a person skilled in the art typically engages in such experimentation. *In re Angstadt*, 190 USPQ 216 (C.C.P.A 1976).

Many working examples are provided to give further guidance and direction for practicing the invention. Table 1 lists various propellants tested and shows exemplary rocket or engine parameters such as the initial port diameter, the port length, the oxidizer gas flow rate, the burn time, and the resultant regression rate. Relevant fuel variables for a number of propellants are shown in Table 2, and the entrainment onset parameters are shown. Those of skill in the art can easily obtain the physical parameters of other materials as such parameters are widely published in known references or experimentally determined by routine experimentation. Further, guidance and direction are provided in Figure 9, among others showing, the entrainment of the propellant as a function of the molecular weight. These are exemplary, and the Applicant

respectfully submits that there is considerable teaching, guidance and direction in the specification and drawings on how to practice the claimed invention.

Additionally, claim 49 recites specific surface tension and viscosity ranges of the liquid layer formed during combustion. One skilled in the art can make these measurements without undue experimentation.

The breath of the claimed invention is not unlimited as the Examiner suggests. Claim 14 is limited by a range of values of a_{onset}. Applicant submits that it is not correct that an infinite number of combinations and permutations of ingredients are possible. Thus, it is propellants that satisfy the recited range of a_{onset} and that combust with the flowing gas fall within claim 14. Claim 49 sets forth specific viscosity and surface tension values, again it is propellants that form a liquid layer upon combustion with the recited viscosity and surface tension values will satisfy claim 49.

Applicant respectfully submits that the correct standard is that one of ordinary skill in the art should be able to practice the claimed invention without *undue* experimentation, not "with but little (reasonable) experimentation" as stated by the Examiner on page 5.

35 U.S.C. 102(b) and 103(a) Rejections

The Examiner rejects Claims 14-19, 21 and 49 under 35 U.S.C. 102(b) as anticipated by or, in the alternative under 35 U.S.C. 103 as obvious over each of Strickler, Anderson and Goode et al. Applicant respectfully traverse the rejections and submits that none of the cited prior art references teach, or reasonably suggest, the method of the present invention.

Stickler teaches that the overall rate of the combustion process is limited by the rate at which heat is transferred to the solid fuel dQ/dt (Col. 2, lines 1 to 15). This is the conventional focus on heat transfer as the dominant mechanism. Stickler teaches increasing the heat transfer, and in particular roughening the surface to create droplets into the gas during combustion. Strickler is limited to this mechanism and does not teach or suggest a method of combusting having a melt layer which satisfy specific criteria as recited in Applicant's claims. None of the prior art references teach or suggest the concept of an entrainment onset parameter, let alone suggest how one would develop such a relationship. None of the prior art references teach or reasonably suggest a method of combusting with a propellant having an a_{onset} value of equal to or less than 0.9. or the range of values of such a parameter. None of the prior art references teach or reasonably suggest the viscosity and surface tension values recited in Claim 49. It is propellants in these ranges recited in claims 14 and 49 that the inventors have discovered exhibit superior, and unexpected, regression rates. This has been demonstrated in the video presentation and has been made of record in previous communications.

Applicant respectfully submits that after reading Strickler, Anderson and Goode, either alone or in combination, one would not be motivated to arrive at Applicant's claimed invention.

Based on the foregoing, Applicant respectfully submits that the application is now in condition for allowance. A copy of the claims showing the changes made are attached hereto and marked as "**Version of Claims Showing Changed Made**". If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. The Commissioner is authorized to charge any additional fees to Deposit Account No. 50-2319 (Order No. A-67587-1/AJT/MSS).

Respectfully submitted,

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Version of Claims Showing Changes Made

14. (Amended) A method of combusting a propellant [that exhibits desirable regression rate during combustion] within a port having a gas stream flowing through the port, comprising the steps of:

flowing the gas stream through the port; and

combusting said propellant and gas wherein said propellant,

[providing a propellant having] under heat transfer from the gas stream flowing though the port, forms a liquid layer with surface tension σ and liquid viscosity μ_l values that promote entrainment of droplets from said liquid layer into said gas stream flowing in said port, and said propellant has an a_{onset} value, where a_{onset} is the entrainment onset parameter and is given by:

$$a_{onset} = 1.05 \times 10^{-2}[\rho g^{1.3} / \rho_l^{0.3}] [1 / (0.03 C_{Bl})^{0.8}] (1 / \mu_g) \sigma \mu_l^{0.6};$$

where ρg is the average density of the gas stream in the port, ρ_l is the average density of the propellant in the liquid layer, C_{Bl} is the blowing correction coefficient and is given by:

$$C_{Bl} = (2 / 2 + 1.25 B 0.75)$$

where $0 < B < 15$, and μg is the mean gas viscosity of the gas stream in the port, and [the units of] a_{onset} is equal to or less than approximately 0.9 $kg^{1.6} / (m^{2.6}\text{-}sec^{1.6})$;

[flowing the gas stream through the port; and]

[combusting said propellant and gas wherein said propellant has a value of a onset that promotes entrainment of droplets from said liquid layer into said gas stream flowing in said port.]

Cancel Claims 15 – 18.

19. (Amended) The method of Claim 14 wherein the propellant is [selected from a] comprised of a mixture of one or more paraffin waxes, and carbon black at a concentration in the range of about 0.2 to 2.0 weight percent [group of n-paraffin compounds and mixtures thereof].

Claim 20 previously canceled.

Cancel claim 21.

Claim 48 previously canceled.

49. (Amended) A method of combusting a propellant [that exhibits desirable regression rate during combustion] within a port having an oxidant flowing through the port, comprising the steps of:

flowing the oxidant through the port; and

combusting said propellant and oxidant where

the propellant [forming], under the heat transfer from the oxidant flowing through the port, forms a liquid layer having a liquid viscosity of less than about 1 milliPa-sec, and a surface tension of less than about 25 milliN/m [, such that droplets from said liquid layer are entrained in said oxidant; and]

[combusting said propellant and oxidant].